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### SURGICAL CLIP

The present invention relates to surgical clips and more particularly to ligation clips.

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During surgical procedures, it is often necessary to use several ligation clips. These can be inserted individually into a suitable applicator, but is more efficient if several clips can be loaded into an applicator preferably in a replaceable magazine.

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US 5219353 discloses a surgical endoclip comprising a generally U-shaped clip comprising a thin metallic unitary member and including a latch member incorporated in a lower section of the clip.

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GB 2177748-A. discloses a Filshie clip having upper and a lower jaw members which are connected by a hinge and including co-operating latching means on said upper and lower jaw members the upper jaw member being curved.

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The present invention has for a first object to provide a clip in particular suitable as a ligation clip which can be loaded into a relatively narrow diameter magazine for delivering such clips down a tube which may be inserted down a cannula.

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During surgical procedures, ligation clips can be extensively used; several may be applied to various anatomical structures in the course of one operation.

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State of the art clips are limited to the use on anatomical structures up to 5mm in diameter after which their effectiveness becomes impaired.

It is the object of this invention to provide a ligation clip that can be used on anatomical structures up to and in excess of 5mm in diameter.



and thirdly to be able to be lockable by the applicator to effect closure of a blood vessel. A mere enlargement of existing clip design may not achieve a satisfactory locking procedure for the enlarged clip.

- 5 It is an object of the present invention to provide a surgical clip which can occlude larger structures and also which can preferably be inserted into a narrow applicator for subsequent insertion down a narrow cannula.

10 In a specific example the cannula can be less than 7mm in diameter and in a preferred example it can be less than 5mm in diameter.

The present invention provides a surgical clip as claimed in Claim 1.

- 15 In a preferred embodiment, the arcuate section comprises a third generally straight section adjacent to said curved section at the opposite end of the upper jaw to the large section said substantially straight section, when in the closed position of the clip interlocking under the latching section of the lower jaw.

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Embodiments of the present invention will now be described, by way of example with reference to the accompanying drawings in which:

Figure 1 shows an enlarged side elevation view of a first clip in accordance with the present invention, the figure also showing by way of comparison a side elevation view of a known sterilisation clip;

Figure 2 shows diagrammatically a longitudinal cross-section of a part of an applicator illustrating the portion of the clip of the present invention in a magazine section of the applicator and also in the operable position in which position the clip is closed, as illustrated,

Figures 3 to 5 diagrammatically illustrate the advantageous design of the clip of the present invention during closure,

Figure 6 shows an enlarged side elevation view of a second clip in accordance with the present invention,

Figure 7 shows a cross sectional view on line 'A-A' of Figure 6 illustrating the cross sectional shape of the silicone rubber lining of the upper jaw of the clip,

Figure 8 shows a cross sectional view on line 'B-B' of Figure 6 illustrating the cross sectional shape of the silicone rubber lining of the lower jaw of the clip,

Figure 9 shows a detail of the end, closure section of the upper jaw of the clip of Figure 6 and

Figure 10 shows the upper jaw of the clip of figure 6 in greater detail.

With reference to Figure 1, a clip 10 according to the present invention is shown in side elevation.

5 The clip comprises an upper jaw section 12 and a lower jaw section 14. The lower jaw section 14 has a latch portion 16 at one end a hinge portion 18 at the other end.

The upper jaw 12 is hinged by a hinge pin 20 to the lower jaw.

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The upper jaw 12 comprises at least two shaped sections. A first section 120 comprises a relatively straight short section and the second section 122 comprises a relatively gently curved section.

15 A third section 124 comprising a co-operating latch portion may be provided at the end of the upper jaw opposite to the hinge 18.

20 In a practical clip (see Figure 2) one or both jaws 12, 14 will be provided with a silicone rubber lining but this is not shown in Figure 1 for ease of viewing.

The jaw 12 is shown in a second position 12' to illustrate movement of the jaw which is further illustrated in Figure 2.

25 By way of contrast, a known sterilisation clip 30 (the Filshie clip - see GB Patent Application No. 2177748A) is shown in Figure 1 having a bottom jaw 34 and top jaw 32 and using the same hinge 18. The latch portion 36 can be seen to be substantially nearer to the hinge 18 than the latch portion 16 of the clip according to the present invention.

The top jaw 32 is as shown a substantially constant curve.

The advantage of the clip design according to the present invention is that the straight section and shallow curve allows the clip (see Figure 2) to pass down (or be fed down) a relatively narrow diameter (H) tube and also to then open to provide an opening (capture) width W which is substantially greater than the height H even with the presence of the silicone rubber lining 40.

10 The straight section 120 in combination with the shallow curve section operates in a manner which is particularly advantageous with a slightly longer clip. The original Filshie clip provides an overall clip length of approximately 14mm but the new clip can be 16mm or greater.

15 If the original clip design were to be made longer then the upper jaw would be a longer arcuate curve. When pressure is applied to this curve, the upper jaw will deform but the combination of longer jaw and the silicone lining may cause the upper jaw end section 124 to either completely fail to enter under the latch section 16 (Fig 4) or possibly to  
20 meet against the end position 160 (Fig 3) and not slide under the latch.

In the first case, the surgeon will be aware that the clip has failed but in the second case Fig 3 the surgeon may assume that correct closure has occurred but the clip will fail at a later stage due to the pressure exerted  
25 by the silicone rubber lining after the operation has been completed.

With the present design of the upper jaw, with the initial straight section it can be seen in Figure 5 that the jaw when distorted by the applicator fits within the latch because the initial closing pressure is on the straight  
30 section and thus the initial pressure does not distort the curved section

until the end portion 124 (Fig 1) has been depressed towards the lower jaw 14.

Figure 6 shows an alternative design clip 60 comprising a lower jaw 622 and an upper jaw 642. As in Figure 1 the lower jaw comprises a hinge portion 620 an elongate relatively straight portion 640 and a latch portion 646.

The upper jaw 642 comprises four separate straight and arcuate sections. A first substantially straight portion 640, a second arcuate portion 641 having a radius RX (Figure 10) and a third arcuate portion 644 having a radius RY (Figure 10) and a fourth substantially straight section 646.

At the distal end from hinge section 620 the portion 646 is provided to latch under lip 626.

The clip 60 is preferably lined with silicone rubber linings 628 and 648 respectively attached to the lower and upper jaws 622, 642.

The profiles of the linings 628, 648 are shown respectively in Figures 7 and 8 and comprise a sinusoidal shape on the internal surface. This shape provides the desired property of the silicone rubber lining of being able to grip the vessel to be occluded whilst still being able to exert the necessary occlusion force when the clip has been closed.

With reference now to Figure 9 the end section 646 (Fig 6) of the upper jaw comprises a relatively short straight section and the silicone rubber lining is provided with a tongue 6480 which is relatively thin in comparison with the rest of the lining 648.

The tongue 6480 serves to initially capture the vessel to be occluded providing in effect an extension to the upper jaw. Because the tongue 6480 is relatively thin it is readily squashed into the silicone rubber lining 5 628 of the lower jaw thereby not preventing closure of the clip.

With reference now to figure 10 in order to effect satisfactory closure of the clip whilst allowing the clip to pass down a relatively small diameter tube the upper jaw of the clip is provided with a first substantially straight 10 portion 640 at the proximal end nearest the hinge as in the embodiment of Figure 6.

In this embodiment the upper jaw is then provided with two arcuate sections 641 and 644.

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Arcuate section 641 has a radius of curvature RX much larger than that of section 644 (R2). In a specific embodiment the radius of arcuate of RX is 11.9mm and that of RY is 4.6mm.

20 The use of two different radii in combination with the straight section allows the clip in this embodiment to be fed down a small diameter tube in a semi closed position to be openable at the end of the tube and to then be latched without risk of the upper jaw being distorted when the latching pressure is applied.